CLAIMS

What is claimed is:

Sub A1

1. An optical transmission system for compensating for transmission loss, comprising:

a transmitting apparatus for serializing a plurality of n-bit channel data, where n is a natural number, received from an external source, in response to a predetermined clock signal, converting the serialized channel data and the predetermined clock signal into a current signal, the magnitude of which changes in accordance with an error detection signal, and outputting optical signals having optical output power corresponding to the magnitude of the current signal;

a first optical fiber for transmitting the optical signals;

a receiving apparatus for recovering the n-bit channel data and the predetermined clock signal from the optical signals received through the first optical fiber, detecting transmission loss generated when the optical signals are transmitted and received, optically converting the transmission loss, and outputting the optically converted transmission loss as the error detection signal; and

a second optical fiber for transmitting the optical converted error detection signal to the transmitting apparatus.

2. The optical transmission system of claim 1, wherein the transmitting apparatus comprises:

a first phase locked loop (PLL) for generating a clock signal synchronized with the predetermined clock signal as a first synchronized clock signal and outputting the first synchronized clock signal as an actual clock signal for data transmission;

a parallel/serial data converter for receiving a plurality of n-bit channel data in response to the first synchronized clock signal, serializing the n-bit channel data in

response to the first synchronized clock signal, and outputting the serialized n-bit channel data;

a receiver optical diode for receiving and converting the error detection signal transmitted from the second optical fiber into a current signal and outputting the current signal;

an error compensating optical driver for converting the serialized channel data and the first synchronized clock signal into current signals, changing the magnitudes of the converted current signals in accordance with the current signal output by the receiving optical diode, and outputting the current signals as driving signals; and

a plurality of transmitting optical diodes for outputting optical signals having optical output power corresponding to the driving signals.

3. The optical transmission system of claim 2, wherein the parallel/serial data converter comprises:

a data latch for receiving the n-bit channel data and segmenting and latching the n-bit channel data by N (N is a natural number) bits in response to first through m (m is a natural number) th latch clock signals; and

a data serializer for performing a logic operation on the n-bit channel data latched by the data latch, first through nth non-overlapping clock signals, and inverted first through nth non-overlapping clock signals and outputting the logic operation result as the serialized channel data,

wherein the first through nth non-overlapping clock signals are generated by the phase locked loop (PLL) and have a predetermined offset so as not to overlap each other.

4. The optical transmission system of claim 2, wherein the error ~~compensating optical driver comprises:~~

an optical receiver for receiving the error detection signal, converting the received error detection signal into a voltage signal, converting the level of the converted voltage signal, and outputting a digitized error compensation signal;

a transmission loss compensator for recovering transmission loss data in each channel from the error compensation signal in response to the first synchronized clock signal, analog converting the recovered transmission loss data, and generating analog converted transmission loss data as transmission loss compensation signals;

an optical output controller for generating optical output control signals in response to the transmission loss compensation signals; and

a plurality of optical drivers for converting the serialized channel data and the first synchronized clock signal into current signals, changing the magnitudes of the converted current signals in response to the corresponding optical output control signals, and outputting the current signals as the driving signals.

5. The optical transmission system of claim 1, wherein the receiving apparatus comprises:

a plurality of optical diodes for receiving optical signals transmitted through the first optical fiber and converting the optical signals into current signals;

an error detection optical receiver for converting the current signals converted by the plurality of optical diodes for reception into voltage signals, digitizing the voltage signals, outputting digitized signals as serial channel data and a recovered clock signal, detecting transmission loss of each channel from the voltage signals, encoding the transmission loss, converting the encoded transmission loss into current, and outputting the current;

a second PLL for generating a second synchronized clock signal synchronized with the recovered clock signal and outputting the second synchronized clock signal as an actual clock signal for receiving data;

a data recovery unit for recovering the recovered serial channel data to n-bit parallel data in response to the second synchronized clock signal; and

an optical diode for transmission for converting a signal encoded and converted into current by the error compensation optical receiver into an optical signal.

6. The optical transmission system of claim 5, wherein the error detection optical receiver comprises:

a plurality of optical receivers for converting the current signals converted by the plurality of optical diodes for reception into voltage signals, outputting the voltage signals, digitizing the voltage signals, and outputting the digitalized voltage signals as the recovered serial channel data and the recovered clock signal;

a transmission loss detector for detecting transmission loss of each channel from the voltage signals, encoding the transmission loss detected in each channel in response to the second synchronized clock signal, and outputting the encoded transmission loss as transmission loss data; and

an optical driver for receiving the transmission loss data, converting the received transmission loss data into a direct current (DC) signal, and outputting the converted DC signal to the optical diode for transmission.

7. An optical transmission system for compensating for transmission loss, comprising:

a transmitting apparatus for serializing a plurality of n-bit channel data received from an external source in response to a predetermined clock signal, converting the serialized channel data and the predetermined clock signal into a current signal, the magnitude of which changes in accordance with an error detection signal, and outputting optical signals having optical output power corresponding to the magnitude of the current signal;

a optical fiber for transmitting the optical signals;

a receiving apparatus for recovering the n-bit channel data and the predetermined clock signal from optical signals received by the optical fiber and

outputting transmission loss generated when the optical signals are transmitted and received as the error detection signal; and

an electrical transmission line for transmitting the error detection signal to the transmitting apparatus.

8. The optical transmission system of claim 7, wherein the transmitting apparatus comprises:

a first PLL for generating a clock signal synchronized with the predetermined clock signal as a first synchronized clock signal and outputting the first synchronized clock signal as an actual clock signal for data transmission;

a parallel/serial data converter for receiving a plurality of n bit channel data from the outside in response to the first synchronized clock signal, serializing the n-bit channel data in response to the first synchronized clock signal, and outputting the serialized n-bit channel data;

an error compensating optical driver for converting the serialized channel data and the first synchronized clock signal into current signals, changing the magnitudes of the converted current signals in accordance with the error detection signal transmitted from the electrical transmission line, and outputting the current signals as driving signals; and

a plurality of optical diodes for transmission for outputting optical signals having optical output power corresponding to the driving signals.

9. The optical transmission system of claim 8, wherein the error compensating optical driver comprises:

a transmission loss compensator for recovering transmission loss data of each channel from the error detection signal in response to the first synchronized clock signal, converting recovered transmission loss data into an analog form, and generating analog converted transmission loss data as transmission loss compensation signals;

an optical output controller for generating optical output control signals in response to the transmission loss compensation signals; and

a plurality optical drivers for converting the serialized channel data and the first synchronized clock signal into current signals, changing the magnitudes of the converted current signals in response to the optical output control signals, and outputting the current signals as the driving signals.

10. The optical transmission system of claim 7, wherein the receiving apparatus comprises:

a plurality of receiving optical diodes for receiving optical signals transmitted through the optical fiber and converting the optical signals into current signals;

an error detection optical receiver for converting the current signals converted by the plurality of receiving optical diodes into voltage signals, digitizing the voltage signals, and outputting the digitized voltage signals as recovered serial channel data and a recovered clock signal, detecting transmission loss in each channel from the converted voltage signals, encoding the transmission loss, and outputting the encoded transmission loss as the error detection signal;

a second PLL for generating a second synchronized clock signal synchronized with the recovered clock signal and outputting the second synchronized clock signal as an actual clock signal for receiving data; and

a data recovery unit for recovering the recovered serial channel data to n-bit parallel data in response to the second synchronized clock signal.

11. The optical transmission system of claim 10, wherein the error detection optical receiver comprises:

a plurality of optical receivers for converting current signals converted by the plurality of receiving optical diodes into voltage signals, outputting the voltage signals, digitizing the voltage signals, and outputting the digitized voltage signals as the recovered serial channel data and the recovered clock signal, and

a transmission loss detector for detecting transmission loss of each channel from the voltage signals, encoding transmission loss detected in each channel in response to the second synchronized clock signal, and outputting the encoded transmission loss as the transmission loss data.

12. A transmitting apparatus for receiving transmission loss detected by an external receiving apparatus through a first optical fiber and transmitting a plurality of channel data to the receiving apparatus through a second optical fiber, comprising:

a PLL for generating a clock signal synchronized with a predetermined clock signal received from an external source and outputting the synchronized clock signal as an actual clock signal for transmitting data;

a parallel/serial data converter for receiving a plurality of n-bit channel data from an external source in response to the synchronized clock signal and serializing the n-bit channel data in response to the synchronized clock signal;

an optical diode for reception for converting an error detection signal transmitted from the first optical fiber into a current signal and outputting the current signal;

an error compensating optical driver for converting channel data serialized by the parallel/serial data converter and the synchronized clock signal into current signals, changing the magnitudes of the converted current signals in accordance with the current signal converted by the optical diode for reception, and outputting the current signals as driving signals; and

a plurality of optical diodes for transmission for outputting optical signals having optical output power corresponding to the driving signals.

13. The optical transmission system of claim 12, wherein the error compensating optical driver comprises:

an optical receiver for receiving the error detection signal, converting the received error detection signal into a voltage signal, converting the level of the converted voltage signal, and outputting a digitized error compensation signal;

a transmission loss compensator for recovering transmission loss data of each channel from the error compensation signal in response to the synchronized clock signal, analog-converting the recovered transmission loss data, and generating the analog-converted transmission loss data as transmission loss compensating signals;

an optical output controller for generating optical output control signals in response to the transmission loss compensation signals; and

a plurality of optical drivers for converting the serialized channel data and the synchronized clock signal into current signals, changing the magnitudes of the converted current signals in response to the optical output control signals, and outputting the current signals as the driving signals.

14. The transmitting apparatus of claim 13, wherein the optical output controller generates the optical output control signals so as to change the modulation current of the driving signals in response to the transmission loss compensating signals.

15. The transmitting apparatus of claim 13, wherein the optical output controller generates the optical output control signals so as to change the bias current of the driving signals in response to the transmission loss compensation signals.

16. The transmitting apparatus of claim 13, wherein the transmission loss compensator comprises:

a decoder for decoding the error compensation signal in response to the synchronized clock signal and outputting the decoding result as transmission loss data of each channel; and

an analog-to-digital converter for receiving the transmission loss data of each channel, converting the transmission loss data into an analog signal, and generating the analog signal as transmission loss compensation signals for compensating for ~~transmission loss of each channel.~~

17. A receiving apparatus for receiving channel data transmitted from an external transmitting apparatus through an optical fiber and recovering the channel data from a received optical signal, comprising:

a plurality of optical diodes for reception for receiving optical signals received from an external source and converting the optical signals into current signals;

an error detection optical receiver for converting the current signals converted by the plurality of optical diodes for reception into voltage signals, digitizing the voltage signals, outputting the digitized voltage signals as recovered serial channel data and a recovered clock signal, detecting transmission loss of each channel from the voltage signals, encoding the transmission loss, converting the encoded transmission loss into current, and outputting the current;

a PLL for generating a synchronized clock signal synchronized with the recovered clock signal and outputting the synchronized clock signal as an actual clock signal for receiving data;

a data recovery unit for recovering the recovered serial channel data to n-bit parallel data in response to the synchronized clock signal; and

an optical diode for transmission for converting the signal encoded and inverted into current by the error compensating optical receiver into an optical signal.

18. The receiving apparatus of claim 17, wherein the error detection optical receiver comprises:

a plurality of optical receivers for converting current signals converted by the plurality of optical diodes for reception into voltage signals, digitizing the voltage signals, and outputting the digitized voltage signals as the recovered serial channel data and the recovered clock signal;

a transmission loss detector for detecting transmission loss of each channel from the voltage signals, encoding the transmission loss in response to the synchronized clock signal, and outputting the encoded transmission loss as the transmission loss data; and

an optical driver for receiving the transmission loss data, converting the received transmission loss data into a DC signal, and outputting the converted DC signal to the optical diode for transmission,

wherein the converted voltage signals are formed of voltage signal pairs having phases that are inverted with respect to each other.

19. The receiving apparatus of claim 18, wherein the transmission loss detector further comprises:

an amplitude detector and comparator for selecting a voltage signal among the voltage signal pairs output from the plurality of optical receivers, detecting the amplitude of the selected voltage signal, comparing the detected amplitude with a first predetermined reference voltage, and obtaining transmission loss of each channel using the comparison result;

a first ADC for digitalizing transmission loss of each channel, which is output from the amplitude detector and comparator in response to the synchronized clock signal; and

an encoder for encoding digital signals output from the first ADC in each channel in response to the synchronized clock signal and outputting the encoded digital signals as loss detection data in response to the synchronized clock signal.

20. The receiving apparatus of claim 18, wherein the transmission loss detector comprises:

a plurality of difference signal detectors and comparators for receiving the voltage signal pairs from the plurality of optical receivers, obtaining the difference between the average levels of each of the voltage signal pairs, comparing the difference between the average levels with a second predetermined reference voltage, and obtaining transmission loss of each channel using the comparison result;

a second ADC for digitizing transmission loss of each channel, which is output from the plurality of difference signal detectors and comparators, in response to the synchronized clock signal; and

an encoder for encoding digital signals output from the second ADC in each channel in response to the synchronized clock signal and outputting the encoded data as loss detection data.

21. A parallel/serial data converting circuit of a transmitting apparatus, comprising a PLL for generating first through nth non-overlapping clock signals having a predetermined offset so as not to overlap each other and inverted first and nth non-overlapping clock signals obtained by inverting the first through nth non-overlapping clock signals, the parallel/serial data converting circuit for converting n-bit channel data input from the outside into serial information data in response to the first through nth overlapping clock signals and transmitting the serial information data, comprising:

a data latch for receiving the n-bit channel data and segmenting the received n-bit channel data by N bits and latching the segmented channel data in response to first through mth latch clock signals; and

a data serializer for performing a logic operation on the n-bit channel data latched by the data latch, the first through nth non-overlapping clock signal and the inverted first through nth non-overlapping clock signal and outputting the logic operation result as serial channel data.

22. The parallel/serial data converting circuit of claim 21, wherein the predetermined offset corresponds to the width of the unit bit of the serial information data.

23. The parallel/serial data converting circuit of claim 21, wherein the first through nth latch clock signals have timing margins corresponding to N unit bits among the first through nth non-overlapping clock signals and the first latch clock signal is the

non-overlapping clock signal having the largest timing margin with respect to the first non-overlapping clock signal.

24. The parallel/serial data converting circuit of claim 21, wherein the data serializer comprises:

a first logic operator realized by n NAND operators corresponding to the bits of the n bit channel data and the first through nth non-overlapping clock signals, and the inverted second through inverted first non-overlapping clock signals, the NAND operators for performing a NAND operation on the respective bits of the n-bit channel data, the non-overlapping clock signals, and the inverted non-overlapping clock signals;

a second logic operator realized by p NAND operators for segmenting the output data of the n NAND operators into p groups and performing a NAND operation on the segmented data; and

an OR operator for performing an OR operation on the output data of the second logic operator.